LUMEL

ELECTRONIC MULTI-TARIFF THREE-PHASE WATT-HOUR METER WITH DIGITAL COMMUNICATION

LS31 Type

USER'S MANUAL

CE

CONTENTS

1. APPLICATION 5
2. SET OF THE ENERGY WATT-HOUR METER 5
3. WATT-HOUR METER DESIGN 5
4. INSTALLATION 7
5. DISPLAY OF INFORMATION 10
6. CHANGING THE WATT-HOUR METER CONFIGURATION 12
7. ENERGY MEASUREMENT 18
8. POWER REGISTERS 19
9. CLOSURE OF THE ACCOUNTING PERIOD 19
10. AVAILABLE TARIFF GROUPS 20
11. OPTICAL INTERFACE 22
12. RS-485 or RS-232 INTERFACE WITH MODBUS PROTOCOL 28
13. INTERNAL CONTROL CLOCK 32
14. TECHNICAL DATA 32
15. ORDER CODES 34
16. MAINTENANCE AND WARRANTY 35

1. APPLICATION

Multi-tariff three-phase watt-hour meters of LS31 type, resistant against external magnetic fields, are destined to be applied in dwelling-house, commercial and industrial buildings.

Submitted to the interaction by strong external magnetic fields, they ensure the correct measurement of the electric energy consumption and the recording of the magnetic field presence together with transmitted information through the wire or wireless interface.

This series of new LS31 electronic energy watt-hour meters enables the elimination of the effect of magnet use to falsify watt-hour meter indications.

Watt-hour meters are equipped with the RS-485/MODBUS communication interface and the radio transmitter gives the possibility of a continuous monitoring, data archiving, visualisation and report. Thanks to the load measurement in each of L1, L2, L3 phases, they enable to analyse the network load asymmetry of network loads.

These watt-hour meters can be connected to Ethernet computer networks, what is enabled through interface converters and protocols offered by Lumel.

The carried out special Lumel-Control software developed in the Lumel's Design Department, enables the creation of complex systems monitoring the energy consumption and other parameters.

2. SET OF THE WATT-HOUR METER

The set consists of:

- LS31 watt-hour meter ..... 1 pc.
- User's manual ..... 1 pc.
- Warranty card ..... 1 pc.

When unpacking the instrument, please check whether the type and execution code on the data plate correspond to the order.

3. WATT-HOUR METER DESIGN

The construction of the LS31 watt-hour meter is presented on the fig. 1

The watt-hour meter housing is made of lexan and ensures the servicing safety in the II protection degree. It consists of the base (1), terminal box (2), shield (3), and terminal case shield (4).

The shield is fixed to the base by means of two internal catches and two screws (5) enabling the sealing by the manufacturer or the application of the verification mark.

The cover of the terminal box is fixed to the terminal box by two screws (6) adapted to its sealing with lead by the energy power plant. At the lower part of the base, there are holes which together with the upper hanger (7) define the fixing points of the watt-hour meter to the cubicle or the niche destined to place the watt-hour meter.

The shield has a transparent window enabling the readout of the display indications.

Under the watt-hour meter shield, a 7-digit LCD (8) display with graphical symbols is placed.

The standard equipment includes an impulse diode (9) with a defined imp/kWh time-constant and an optical link (10) enabling the readout of stored data by the watt-hour meter.

The review and setting of watt-hour meter parameters is realised by the button (11) installed on the shield. The button is adapted to be sealed with lead. The function of parameter setting is accessible only after removing the leaden seal from the button.

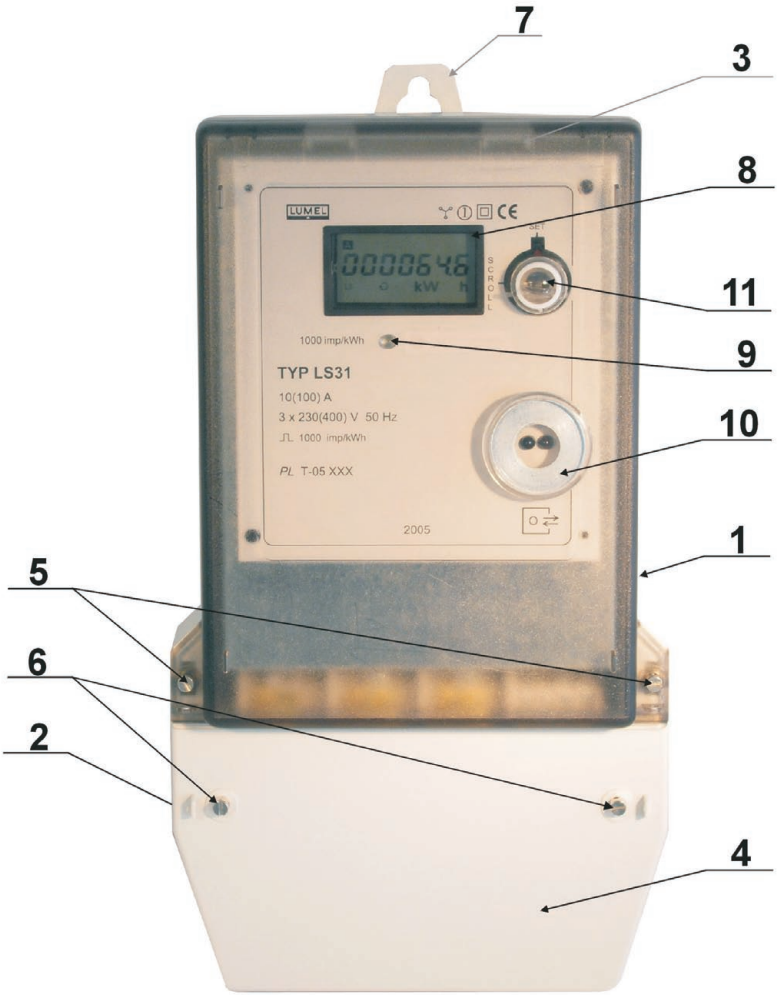


Fig. 1 Watt-hour meter design.

4. INSTALLATION

4.1. External dimensions and fixing way

LS31 watt-hour meters are intended to be assembled on a wall.

The box is equipped with screw terminals, with 9.4 mm of internal diameter (for 100 A a.c.), and 7.0 mm (for 60 A a.c.) for the connection to the power network, and auxiliary terminals enabling the connection of auxiliary circuits by a wire of 2.5 mm^2 cross-section. Overall dimensions of the watt-hour meter are presented on the fig. 2.

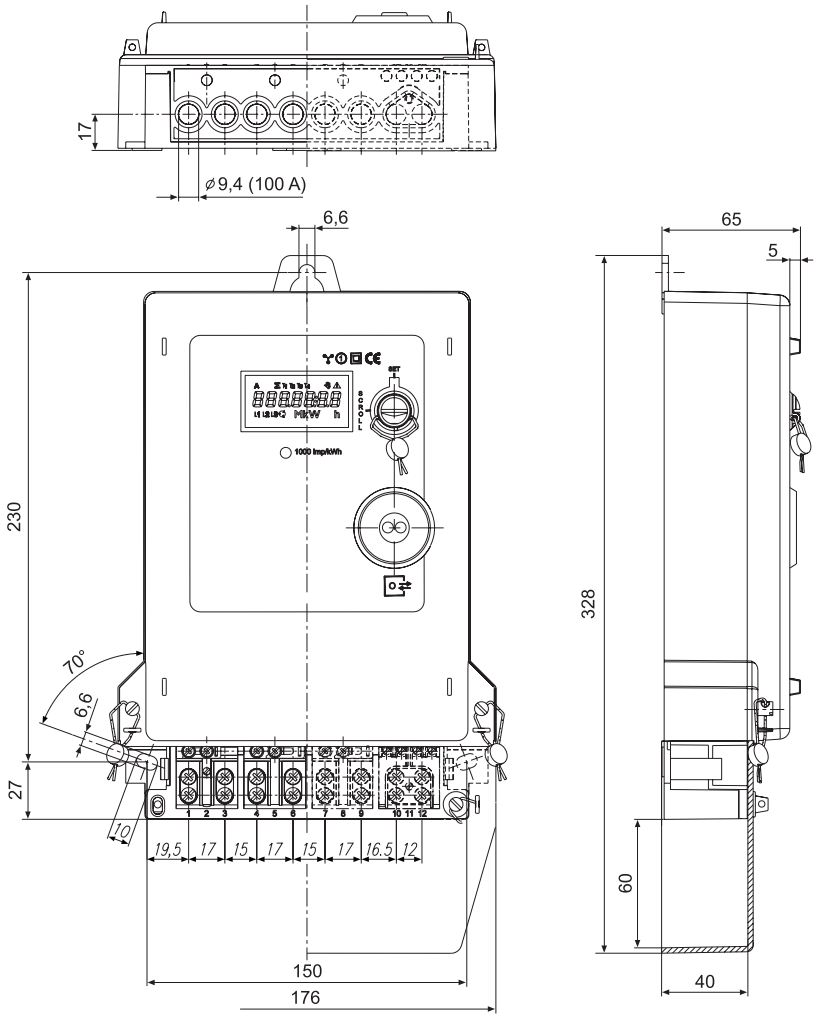
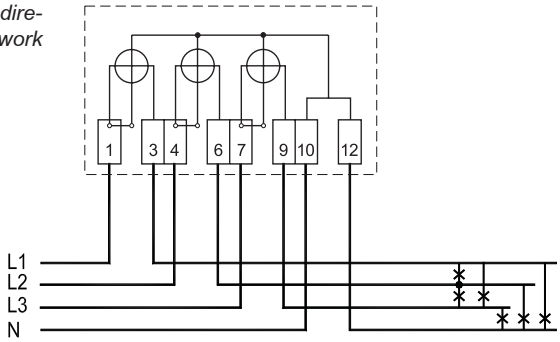


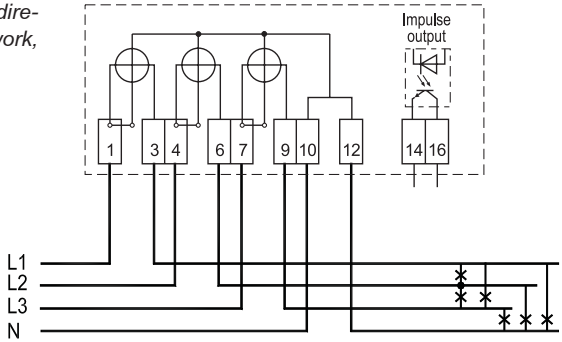
Fig. 2 Overall design of the LS31 watt-hour meter

4.2. Connection diagrams

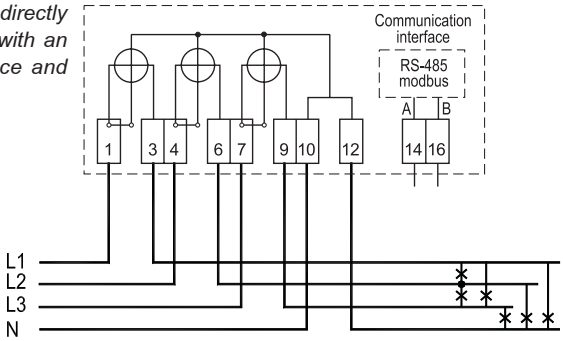
Three-phase watt-hour meter directly connected to a 4-wire network



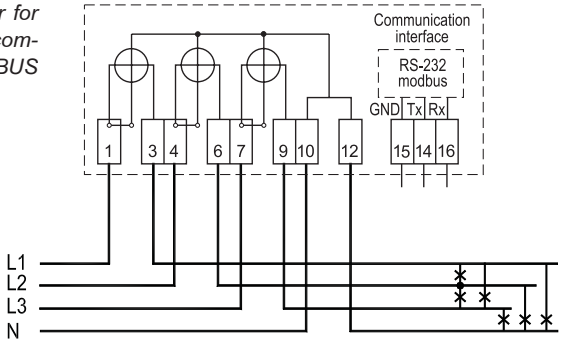
3-phase 4-wire watt-hour meter directly connected to a 4-wire network, with impulse output



3-phase 4-wire watt-hour meter directly connected to 4-wire network, with an RS-485 communication interface and MODBUS protocol



3-phase 4-wire watt-hour meter for direct connection with RS-232 communication interface and MODBUS protocol.



3-phase 4-wire watt-hour meter directly connected ito a 4-wire network with radio SRD/IE/ inter-

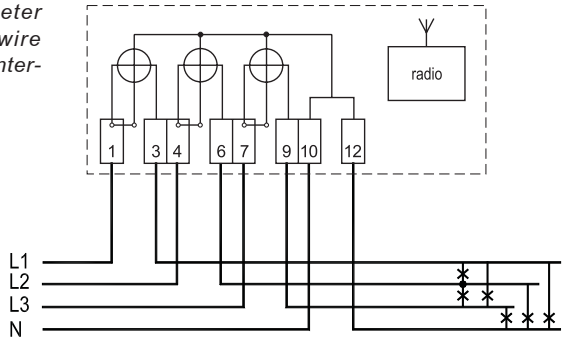


Fig. 3 External connection diagrams of the watt-hour meter

5. Displayed information

The readout of following information is possible on the LCD display:

- Energy in the current zone,
- Current time (in format hour : min),
- Current date (in format year : month : day),
- Energy in zone T1,
- Energy in zone T2 (if occurs in the set tariff group),
- Energy in zone T3 (if occurs in the set tariff group),
- Energy in zone T4 (if occurs in the set tariff group),
- Total energy,
- Energy L1,
- Energy L2,
- Energy L3,
- Time of the accounting period closure (in format hour : minute),
- Date of the accounting period closure (in format year : month : day),
- Energy in zone T1, at the end of the previous accounting period,
- Energy in zone T2, at the end of the previous accounting period,
- Energy in zone T3, at the end of the previous accounting period,
- Energy in zone T4, at the end of the previous accounting period,
- Total energy, at the end of the previous accounting period,
- Symbol of the set tariff group.

The beginning of parameter review, i.e. the transition from the energy displaying of the current zone, follows after pressing the push-button in the SCROLL position. Successive information are accessible sequentially. After 30 seconds from the last button pressure, the watt-hour meter returns to the normal working mode.
Depending of the version and watt-hour meter configuration, the quantity of accessible information in the review mode can be lower.

5.1. Appearance of the LCD display

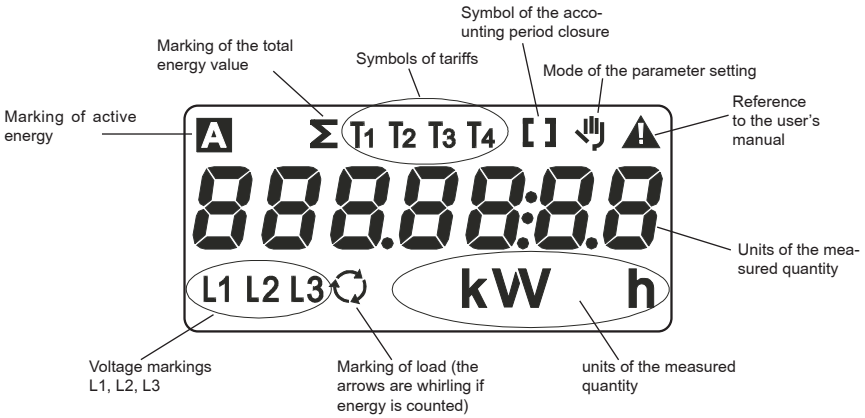

Symbol of the accounting period closure
Marking of the total energy value
Symbols of tariffs
Mode of the parameter setting
Marking of active energy
Reference to the user's manual
A
Σ T1 T2 T3 T4
Units of the measured quantity
L1 L2 L3
kW
h
Voltage markings L1, L2, L3
Marking of load (the arrows are whirling if energy is counted)
units of the measured quantity

Fig. 4 LCD display

5.2. Displayed energy

In the LS31 watt-hour meter directly connected, energy is displayed in kWh, with one decimal place.
The watt-hour meter display has 7 digits.

5.3. LED impulse output

The lighted LED red diode shows that energy is flowing. The diode is flickering proportionally to the energy flow.

5.4. Signalling of phase voltage presence

Fig. 5 Indicators of the presence of phase voltages

Markings L1, L2, L3 signal the presence or the lack of voltage in individual phases.
The lack of a segment means the decrease of the voltage below 0.90 Un or the lack of voltage, whereas the visible marking means the presence of voltage in the given phase.

5.5 Signalling of active tariff zone

Fig. 6 Tariff indicators

The active tariff zone is indicated by one of the symbols, e.g. for the first tariff zone, the symbol T1 is displayed. For total energy of all zones , all accessible tariff symbols are displayed with the itotal marking of the sum Σ.

5.6. Signalling of energy counting

Fig. 7. Indicator of energy counting

For signalling the energy counting, a marking composed of 3 arrows is accessible. When energy is counted, two arrows are shifting and that gives the effect of the marking rotation.
If the watt-hour meter does not count energy, all arrows are visible (they do not rotate). The rotation speed of the marking is constant and does not depend on measured energy.

5.7. Signalling of data from the previous accounting period

Fig. 8 Marking of the accounting period closure

Parameters marked by this mark concern the closed accounting period.

5.8. Signalling of parameter review, programming parameters or interference by a magnetic field

Fig. 9 Marking of parameter review

When the user reviews parameters, programs watt-hour meter registers or is in the configuration change mode, the symbol presented on the fig.9 appears on the LCD display.

The flickering symbol means interference by a strong magnetic field.

If the watt-hour meter in under the interaction of this field, the marking is lighting on a continuous way. If the time of the field action was longer than 30 sec. and the watt-hour meter is not under its influence, then the marking is flickering till the time of erasing magnetic field interference through the optical link or by the button (after removing the leaden seal of the button).

The information about the magnetic field interference is saving in the watt-hour meter memory.

5.9. Signalling of extra information

Fig. 10. Marking of extra information

The above symbol visible on the display, signals that the recording through the optical link is allowed. However, the flickering symbol signals the incorrect watt-hour meter operation.

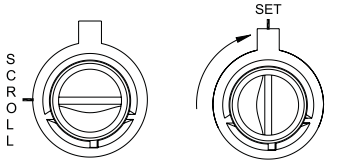
6. CHANGING THE WATT-HOUR METER CONFIGURATION

6. 1. Button

The watt-hour meter has a two-position button. The review of parameters is possible in the SCROLL position. In this position, the button can be sealed with lead. The suilable position of the button is set by means e.g. a wiew driwer.

CAUTION: The button must be tismed in the non-pressed state.

To transit into the SET position, one must remove the leaden seal, turn the button by 90° to the right. The table 1 presents functions of the button.



SCROLL position SET position

Functions of the button Table 1

Button	Working mode	Function
SCROLL	MEASUREMENT	Review of parameters
SCROLL	SETUP	Change of programmable parameter values
SCROLL (> 2 sec.)	SETUP	Automatic incrementation of the parameter value
SET (> 2 sec.)	MEASUREMENT	Entry in the mode of parameter configuration
SET	SETUP	Selection of the parameter
SET (> 2 sec.)	SETUP	Acceptation of the parameter group change

The watt-hour meter transits from the mode of parameter review, or the mode of the parameter configuration, to the normal working mode after 30 sec. since the end of the user's interference.

6.2. Way to change configuration parameters

The scheme of the watt-hour meter main menu is presented on the fig. 11a.

After pressing and holding down the SET button, during at least 2 sec., it is possible to programme parameters. The transition between parameters is carried out by means of the SET button. The description of parameters is included in the table 2. The return to the normal operation mode follows after revising all visible parameter groups or automatically after the laps of 30 sec. since the last button pressure.

CAUTION: Some parameters or parametr settings can be invisible (inaccesible) depending on the watt-hour version and its current configuration.

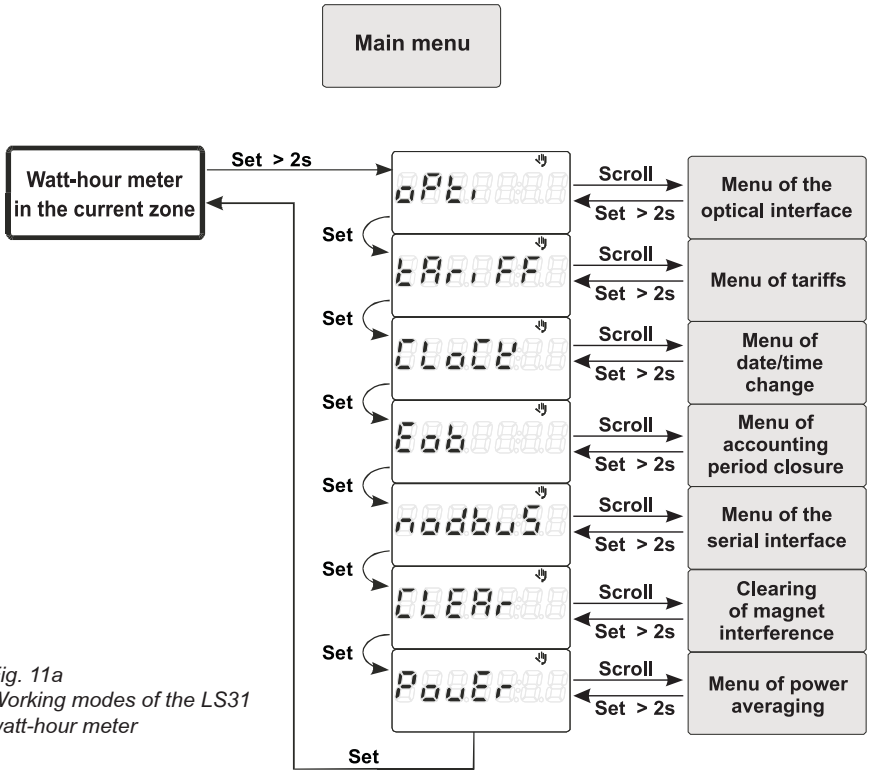


Fig. 11a
Working modes of the LS31 watt-hour meter

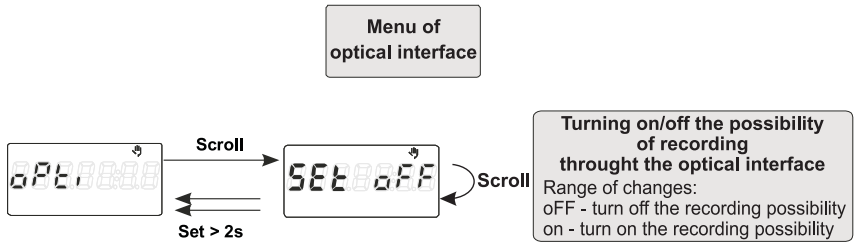


Fig. 11b Watt-hour meter work algorithm - Menu of optical interface

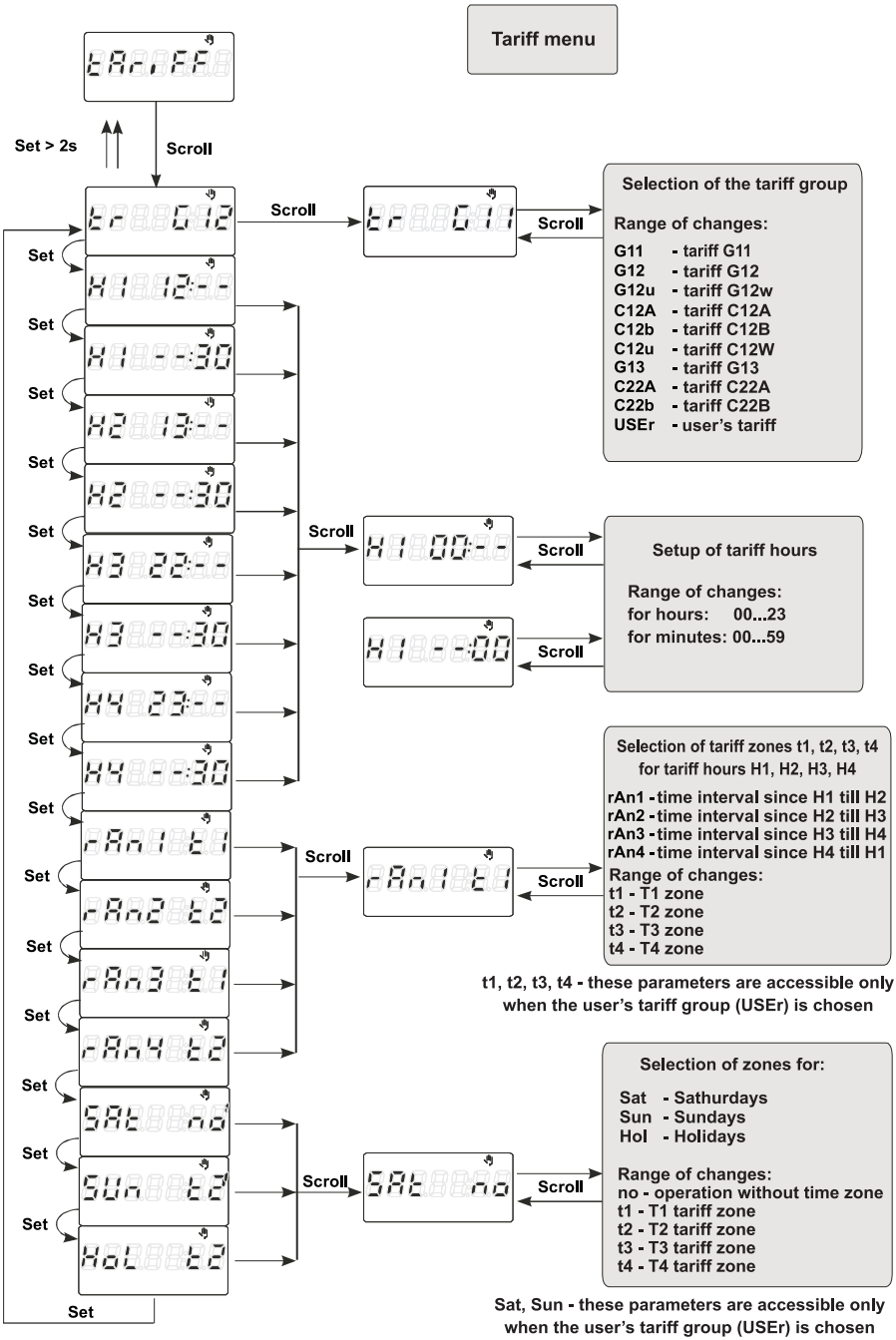


Fig. 11c Algorithm of the watt-hour meter work- tariff menu

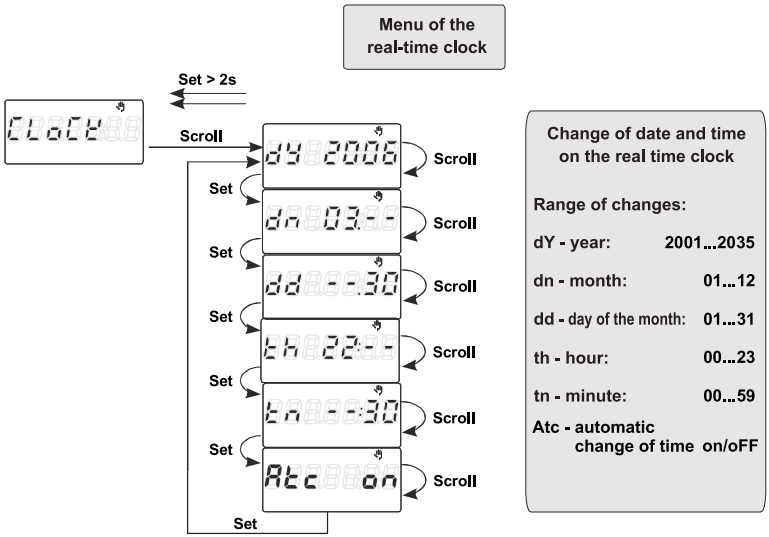


Fig. 11d Algorithm of the watt-hour meter work - menu of the real time clock

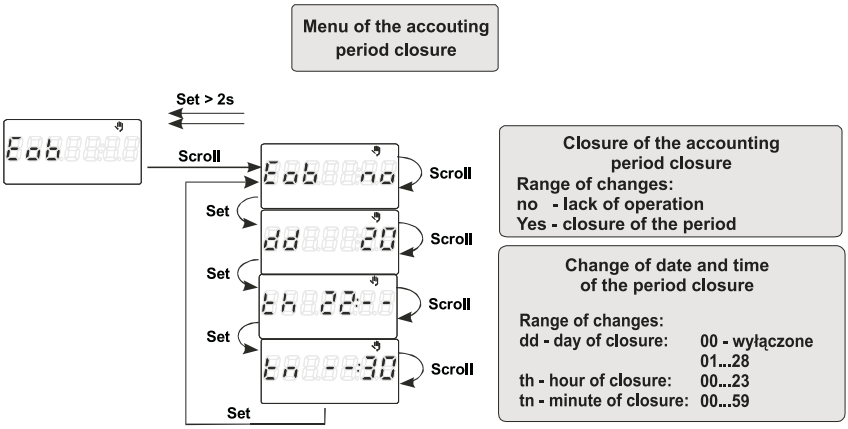


Fig. 11e Algorithm of the watt-hour meter work - menu of accounting

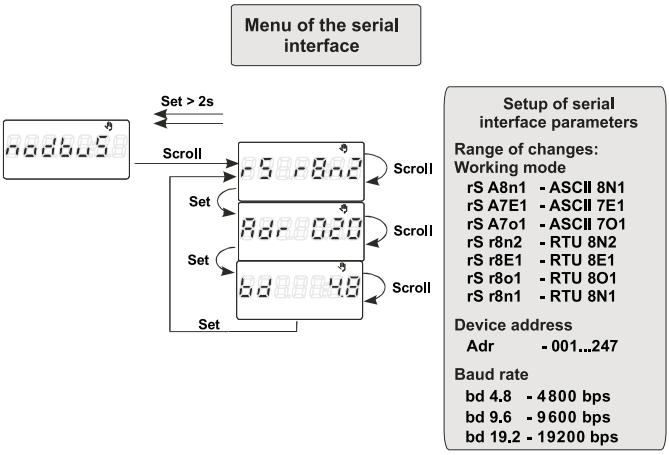


Fig. 11f Algorithm of the Watt-hour meter work - menu of the serial Interface

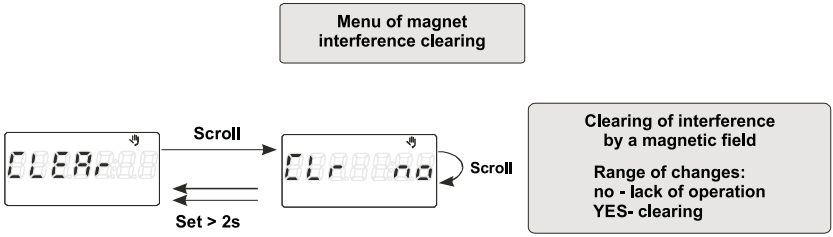


Fig. 11g Algorithm of watt-hour meter work - menu of magnet interference

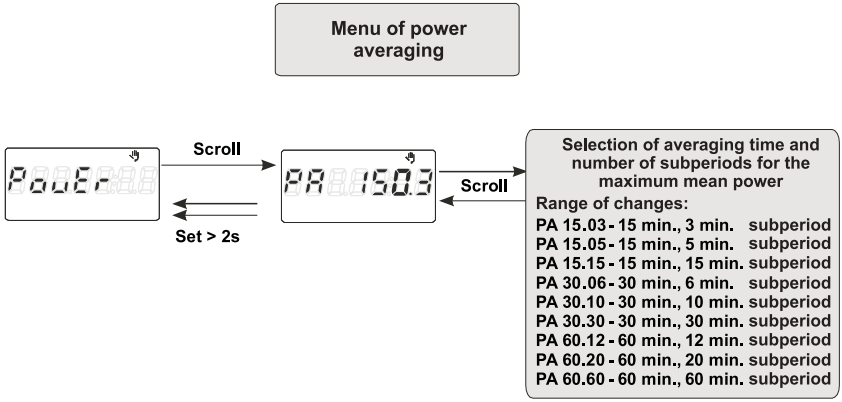

Menu of power averaging
Scroll
Set > 2s
Scroll
Selection of averaging time and number of subperiods for the maximum mean power
Range of changes:
PA 15.03 - 15 min., 3 min. subperiod
PA 15.05 - 15 min., 5 min. subperiod
PA 15.15 - 15 min., 15 min. subperiod
PA 30.06 - 30 min., 6 min. subperiod
PA 30.10 - 30 min., 10 min. subperiod
PA 30.30 - 30 min., 30 min. subperiod
PA 60.12 - 60 min., 12 min. subperiod
PA 60.20 - 60 min., 20 min. subperiod
PA 60.60 - 60 min., 60 min. subperiod

Fig. 11h Algorithm of watt-hour meter work - menu of power averaging

List of configuration parameters Table 2

Main menu	Parameter symbol	Parameter description	Range of parameter changes
oPt.	SEt	Possibility of recording through the optical interface	oFF: disabled on: enabled
tAr. FF	tr	Selection of the tariff	G 11: tariff group G11 G 12: tariff group G12 G 12w: tariff group C12w C 12A: tariff group C12a C 12b: tariff group C12b C 12w: tariff group C12w G 13: tariff group G13 C22A: tariff group C22a C22b: tariff group C22b USEr: User's tariff
	H 1	H1 time for tariff groups G12, G12w, C12b, C12w, USEr	06:00...07:00 or optionally for USEr
	H2	H2 time for tariff groups G12, G12w, C12b, C12w, USEr	13:00...14:00 or optionally for USEr
	H3	H3 time for tariff groups G12, G12w, C12b, C12w, USEr	15:00...16:00 or optionally for USEr
	H4	H4 time for tariff groups G12, G12w, C12b, C12w, USEr	22:00...23:00 or optionally for USEr
	rAn 1	Selection of tariff for the time interval since H1 till H2. **Parameter accesible only in the USEr tariff group**	t 1: T1 zone t2: T2 zone t3: T3 zone t4: T4 zone
	rAn2	Selection of tariff for the time interval since H2 till H3. **Parameter accesible only in the USEr tariff group**	t 1: T1 zone t2: T2 zone t3: T3 zone t4: T4 zone
	rAn3	Selection of tariff for the time interval since H3 till H4. **Parameter accesible only in the USEr tariff group**	t 1: T1 zone t2: T2 zone t3: T3 zone t4: T4 zone
	rAn4	Selection of tariff for the time interval since H4 till H1. **Parameter accesible only in the USEr tariff group**	t 1: T1 zone t2: T2 zone t3: T3 zone t4: T4 zone
	SAt	Selection of tariff zone for Saturdays. **Parameter accesible only for the USEr tariff group.** **The choice of the parameter „Cur" causes that the watt-hour meter counts the energy acc to parameter settings „rAn1... 4".**	Cur: as in chosen tariff group t 1: T1 zone t2: T2 zone t3: T3 zone t4: T4 zone
	Sun	Selection of tariff zone for Sundays. **Parameter accesible only for the USEr tariff group.** **The choice of the parameter „Cur" causes that the watt-hour meter counts the energy acc to parameter settings „rAn1... 4".**	Cur: as in chosen tariff group t 1: T1 zone t2: T2 zone t3: T3 zone t4: T4 zone
	Hol	Selection of tariff zone for Holidays. **The choice of the parameter „Cur" causes that the watt-hour meter counts in the zone which results from the set tariff.**	Cur: as in chosen tariff group t 1: T1 zone t2: T2 zone t3: T3 zone t4: T4 zone

List of configuration parameters Table 2

Main menu	Parameter symbol	Parameter description	Range of parameter changes
clocK	dY	Current year	2001...2035
	dn	Current month	01... 12
	dd	Current day	01...31
	tH	Current hour	00...23
	tn	Current minute	00...59
	Rtc	Automatic change of the winter/summer	oFF: turned off on: turned on
Eob	Eob	Instant execution of the accounting period closure	no: no YES: yes
	dd	Day of automatic closure of the accounting period	01...28
	tH	Hour of automatic closure of the accounting period	00...23
	tn	Minute of automatic closure of the accounting period	00...59
nodbuS	rS	Working mode	A8n 1: ASCII 8N1 A7E 1: ASCII 7E1 A7o 1: ASCII 7O1 r8n2: RTU 8N2 r8E 1: RTU 8E1 r8o 1: RTU 8O1 r8n 1: RTU 8N1
	Adr	Address	1... 247
	bd	Baud rate	4.8: 4800 bit/sec 9.6: 9600 bit/sec 19.2: 19200 bit/sec
CLEAr	CLr	Clearing of the magnet interference	no: no YES: yes
PouEr	PA	Mode of power averaging	15.03: 15 min, subrange 3 min 15.05: 15 min, subrange 5 min 15. 15: 15 min, subrange 15 min 30.06: 30 min, subrange 6 min 30. 10: 30 min, subrange 10 min 30.30: 60 min, subrange 30 min 60. 12: 60 min, subrange 12 min 60.20: 60 min, subrange 20 min 60.60: 60 min, subrange 60 min

7. ENERGY MEASUREMENT

7.1. Energy registration in tariffs

The LS31 watt-hour meter counts energy in one of the tariffs in any time.

When the register reaches its maximal value 999 999.9 kWh, it is automatically reset and the counting begins from zero.

7.2. Registration of total energy

The recording of total energy consists on storage of the whole energy consumption in one register, independently of the tariff. When the register reaches its maximal value: 999 999.9 kWh, it is automatically reset and the counting begins from zero.

7.3. Energy measurement in each phase

The measurement of energy in each phase consists on the storage of energy of each phase in separate registers. When the register reaches its maximal value - 999 999.9 kWh, it is automatically reset and the counting begins from zero

8. POWER REGISTERS

8.1. Averaged maximal power

The measurement of averaged maximal power can be carried out in the period of 15, 30 or 60 minutes. The block mode or the shift mode is accessible to calculate the power index.

For the shift mode, one can choose 5 or 3 sub-periods falling on the integration period. For the 15 minutes' period, segments will be lasted 3 or 5 minutes. For the 30 minutes' period, segments will be lasted 6 and 10 minutes and for 60 minutes' period, segments will be lasted 12 or 20 minutes.

The chosen number of sub-periods composes the integration period of power. After the first complete shift period comprising all sub-periods, the successive sub-period will be counted, and the first will not be taken in account. The watt-hour meter stores in the memory the maximal power for the current and the previous accounting period, and the time and date of its occurrence.

8.2. Cumulated power

The cumulated power is the power register, increased by the value of the averaged maximal power at the end of the accounting period.

9. CLOSURE OF THE ACCOUNTING PERIOD

The closure of the accounting period, ca be carried out manually or automatically. The manual closure of the accounting period can be carried out by means of the button (see table 2) or the optical link (by means of the optical probe and the software servicing the watt-hour meter).

The automatic closure can follow automatically on the defined day of the month, in the set time. The configuration consists on the write of minute, hour and the day of the accounting period closure. The write of value 00 in the closure day causes the automatic switching off of the accounting period closure. At the moment of accounting period closure, energy values the total energy, and maximal power from all time zones will be memorized.

The cumulated power is increased by the value of averaged maximal power. During the accounting period closure, the date and hour of the caried out operatory are stored. In case of lack of closure possibility, e.g. because of the supply lack, the closure process will be carried out after the supply voltage recovery.

After each accounting period closure the counter is increased of one.

Note: It is recommended to close the accounting period during the installation, in order to memorize the initial energy value already counted. If the accounting period closure was made on the day in which should occur the automatic closure, then the automatic closure will be cancelled on this day.

10. AVAILABLE TARIFF GROUPS

10.1. Tariff group G11

The energy is counted all the time in the zone 1.

10.2. Tariff group G12

Table 3

Zone number	Day zone (24 hours)	Season of the year (1 January - 31 December)
1.	Day-time zone (T1)	H_1 - H_2 H_3 - H_4
2.	Night-time zone (T2)	H_4 - H_1 H_2 - H_3

Markings:

H_1: $6^{00} \div 7^{00}$
H_2: $13^{00} \div 14^{00}$
H_3: $15^{00} \div 16^{00}$
H_4: $22^{00} \div 23^{00}$

Holidays are included to the zone depended on the Hol parameter setting in tAriFF

10.3. Tariff group G12w

Table 4

Zone number	Day zone (24 hours)	Season of the year (1 January - 31 December)
1.	Day-time zone (T1)	H_1 - H_2 H_3 - H_4
2.	Night-time zone (T2)	H_4 - H_1 H_2 - H_3

Markings:

H_1: $6^{00} \div 7^{00}$
H_2: $13^{00} \div 14^{00}$
H_3: $15^{00} \div 16^{00}$
H_4: $22^{00} \div 23^{00}$

Holidays are included to the zone depended on the Hol parameter setting in tAriFF
Saturdays and Sundays are included during the all day in the second zone - night zone.

10.4. Tariff group G13

Table 5

Zone number	Day zone (24 hours)	Season of the year	
		Summer (1 April - 30 September)	Winter (1 October - 31 March)
1.	Ante-meridian peak (T1)	7^{00} - 13^{00}	7^{00} - 13^{00}
2.	Post-meridian peak (T2)	19^{00} - 22^{00}	16^{00} - 21^{00}
3.	Remaining hours of the day (T3)	13^{00} - 19^{00} 22^{00} - 7^{00}	13^{00} - 16^{00} 21^{00} - 7^{00}

Day-offs according to the law, Saturdays and Sundays are counted during the day (24 hours) in the third zone as remaining hours of the day.

10.5. Tarif group C12a

Table 6

Zone number	Day zone (24 hours)	Season of the year	
		Summer (1 April - 30 September)	Winter (1 October - 31 March)
1.	Peak zone (T1)	8^{00} - 11^{00} 20^{00} - 21^{00}	8^{00} - 11^{00} 17^{00} - 21^{00}
2.	Exstra-peak zone (T2)	11^{00} - 20^{00} 21^{00} - 8^{00}	11^{00} - 17^{00} 21^{00} - 8^{00}

Holidays are included to the zone depended on the Hol parameter setting in tAriFF

10.6. Tarif group C12b

Table 7

Zone number	Day zone (24 hours)	Season of the year
		(1 January - 31 December)
1.	Day-time zone (T1)	H_1 - H_2 H_3 - H_4
2.	Night-time zone (T2)	H_4 - H_1 H_2 - H_3

Markings:

H_1: $6^{00} \div 7^{00}$

H_2: $13^{00} \div 14^{00}$

H_3: $15^{00} \div 16^{00}$

H_4: $22^{00} \div 23^{00}$

Holidays are included to the zone depended on the Hol parameter setting in tAriFF

10.7. Tarif group C12w

Table 8

Zone number	Day zone (24 hours)	Season of the year
		(1 January - 31 December)
1.	Day-time zone (T1)	H_1 - H_2 H_3 - H_4
2.	Night-time zone (T2)	H_4 - H_1 H_2 - H_3

Markings:

H_1: $6^{00} \div 7^{00}$

H_2: $13^{00} \div 14^{00}$

H_3: $15^{00} \div 16^{00}$

H_4: $22^{00} \div 23^{00}$

Holidays are included to the zone depended on the Hol parameter setting in TariFF

Saturdays and Sundays are counted during the day (24 hours) in the second zone - night zone.

10.8. Tariff group C22a

Table 9

Zone number	Day zone (24 hours)	Season of the year			
		I, II, XI, XII	III, X	IV, IX	V, VI, VII, VIII
1.	Peak zone (T1)	8^{00} - 11^{00} 16^{00} - 21^{00}	8^{00} - 11^{00} 18^{00} - 21^{00}	8^{00} - 11^{00} 19^{00} - 21^{00}	8^{00} - 11^{00} 20^{00} - 21^{00}
2.	Extra-peak zone (T2)	21^{00} - 8^{00} 11^{00} - 16^{00}	21^{00} - 8^{00} 11^{00} - 18^{00}	21^{00} - 8^{00} 11^{00} - 19^{00}	21^{00} - 8^{00} 11^{00} - 20^{00}

Holidays are included to the zone depended on the Hol parameter setting in tAriFF

10.9. Tariff group C22b

Table 10

Zone number	Day zone (24 hours)	Season of the year
		(1 January - 31 December)
1.	Peak zone (T1)	6^{00} - 21^{00}
2.	Extra-peak zone (T2)	21^{00} - 6^{00}

Holidays are included to the zone depended on the Hol parameter setting in tAriFF

10.10. List of holidays (day-free of work)

Foloving holidays being day-offs statutory:

święta stałe: 1st January (New Year),
1st May (international holiday),
3rd May (National Polish holiday of the 3rd May),
15th August (Feast of the Assumption),
1st November (All Sainto day),
11th November (National Independence - holiday in Poland),
25th December (First day of Christmas),
26th December (Second day of Christmas).

mobile holidays: first and second day of Easter,
Corpus Christy.

11. OPTICAL INTERFACE

Set of optical link parameters of the LS31 watt-hour meter.

- compliance with standard — EN 62065-21
- manufacturer's identifier — LML
- Speed identifier — 4
- Watt-hour meter identifier — LS31-LUMEL
- Transmission protocol — Mode C of transmission
- Transmission initialization — 300 bauds
- accessible baud rate — 300, 600, 1200, 2400, 4800, bit/s
- character format — 7E1
- recording locking by the button secured by the leaden seal

The optical interface in the watt-hour meter enables the realization of following functions:
- data readout from the watt-hour meter,
- write of selected parameters into the watt-hour meter,
- closure of the accounting period.

The parameter write and/or closure of the accounting period through the optical interface is possible after the rupture of the the button leader seal.

To unlock or lock the write, one must:
- press the SET button for a time longer than 2 sec,
- pressing the SET button transit to the „oPt, " menu,
- by means of the SCROLL button unlock the „SEt on" notation or lock the „SEt oFF" notation,
- pressing the SET button for a time longer than 2 sec, accept the change,
- pressing the SET button, exit from the main menu configuration.

The write locking follows automatically after a 5 minutes' lack of communication through the optical link.

11. 1 Registers of LS31 watt-hour meter

The table 11 presents the set of watt-hour meter registers together with identifiers and example of contents in case of data readout.

NOTE: Depending of the watt-hour meter version and configuration, the number of registers accessible for readout can be smaller.

Registers of watt-hour meters accessible through the optical interface Table 11

Identifier (ASCII characters)	Format ASCII characters	Parameter
28	12:34:56	Current time (hh:mm:ss)
29	25-11-02	Current date (dd-mm-yy)
0.0	AbcDeFgHiJ	User's identifier
0.0.1	02110001	Serial number
0.8.1	000123.4*kWh	Energy in zone T1
0.8.2	000423.4*kWh	Energy in zone T2
0.8.3	000623.4*kWh	Energy in zone T3
0.8.4	000723.4*kWh	Energy in zone T4
0.8.0	001323.4*kWh	Total energy of all zones
0.8.0.1	000543.1*kWh	Total energy of phase one
0.8.0.2	000654.4*kWh	Total energy of phase two
0.8.0.3	000765.4*kWh	Total energy of phase three
0.6.0	10:23 20-11-02; 99.2*kW	Time and date of maximal power occurrence, 15' or 60' and its value
70.	10:23 20-11-02	Time and date of closing the accounting period
0.8.1*00	000123.4*kWh	Energy in zone T1 at the end of the previous accounting period
0.8.2*00	000423.4*kWh	Energy in zone T2 at the end of the previous accounting period

Table 11

Identifier (ASCII characters)	Format ASCII characters	Parameter
0.8.3*00	000623.4*kWh	Energy in zone T3 at the end of the previous accounting period
0.8.4*00	000723.4*kWh	Energy in zone T4 at the end of the previous accounting period
0.8.0*00	001323.4*kWh	Total energy at the end of the previous accounting period
0.6.0*00	10:23 19-11-02; 90.2*kW	Time and period of 15' or 60' maximal power occurrence in the previous accounting period and its value
0.6	6344.7*kW	Cumulated power (maks. „65535”)
0.1.	22352	Counter of accounting period closure (maks. „65535”)
54.	010301	Watt-hour meter status: 1st character - Signaling of voltage in phase L1 (‘0’-lack; ‘1’-exists) 2nd character - Signalling of voltage in phase L2 (‘0’-lack; ‘1’-exists) 3rd character- Signalling of voltage in phase L3 (‘0’-lack; ‘1’-exists) 4th character - Current time zone: ‘1’ - zone 1 ‘2’ - zone 2 ‘3’ - zone 3 ‘4’ - zone 4 5 th character - reserved (always ‘0’) 6 th character - signalling of interference by a magnetic field (‘0’, ‘1’)
FF	01101000 00011000	Register of watt-hour meter errors (see table 12) (‘0’ or ‘1’)
0.43	7	Time of power averaging and number of sub-periods: ‘0’ - 15 min, sub-period 3 min ‘1’ - 15 min, sub-period 5 min ‘2’ - 15 min, sub-period 15 min ‘3’ - 30 min, sub-period 6 min ‘4’ - 30 min, sub-period 10 min ‘5’ - 30 min, sub-period 30 min ‘6’ - 60 min, sub-period 12 min ‘7’ - 60 min, sub-period 20 min ‘8’ - 60 min, sub-period 60 min
50.	17;13:55	Day and time in which the accounting period is closed (day ‘00’ - automatyczne zamykanie wyłączone; dzień ‘01’...‘28’; godzina ‘00’...‘23’; minuta ‘00’...‘59’)
51.	05	Kind of tariff group: ‘00’ - G11 ‘01’ - G12 ‘02’ - G12w ‘03’ - C12a

Identifier (ASCII characters)	Format ASCII characters	Parameter
51.	05	‘04’ - C12b ‘05’ - C12w ‘06’ - G13 ‘07’ - C22a ‘08’ - C22b ‘09’ - USEr (user’s tariff) ‘10’ - control by the external clock
51.1	07:20; 10:12; 22:30; 23:30	Variable hours for tariffs: G12, G12w, C12b, C12w, User
51.2	1010111	Time zones for tariff hours, Saturdays, Sundays and holidays (tylko dla taryfy USEr) 1 st character - Zone for hour interval since H1 till H2 2 nd character - Zone for hour interval since H2 till H3 3 rd character - Zone for hour interval since H3 till H4 4 th character - Zone for hour interval since H4 till H1
		Meaning of 1... 4 character: ‘0’ - T1 zone ‘1’ - T2 zone ‘2’ - T3 zone ‘3’ - T4 zone
		5 th character - zone for Sathurdays (only for USEr tariff) 6 th character - zone for Sundays (only for USEr tariff) 7 th character - zone for holidays
		Meaning of 5... 7 character: ‘0’ - without time zone ‘1’ - T1 zone ‘2’ - T2 zone ‘3’ - T3 zone ‘4’ - T4 zone In case when the ‘0’ is chosen, time zones are defined acc. to the selected tariff group (see the description of tariff zones in table 2).
52.	22112	Configuration of the serial link (mode, address, baud rate): 1st character - mode ‘1’ - ASCII 8N1 ‘2’ - ASCII 7E1 ‘3’ - ASCII 7O1 ‘4’ - RTU 8N2 ‘5’ - RTU 8E1 ‘6’ - RTU 8O1 ‘7’ - RTU 8N1 2, 3, 4 character - address („001”...”247”) 5 th character - baud rate ‘0’ - 4800 baud ‘1’ - 9600 baud ‘2’ - 19200 baud

Table 11

Identifier (ASCII characters)	Format ASCII characters	Parameter
53.	6.4	Number of the program version
55.	1	Automatic change of the winter/summer time. ‘0’ - disabled ‘1’ - enabled
76.1	10:12 25-11-05;	Hour and date of the first beginning of interference by a strong magnetic field.
76.2	000000327	Duration of interference by a strong magnetic field (sec)
78	00003	Number of interference by a strong magnetic field cleared registers.

FF register description - watt-hout meter errors

Table 12

Character number	Description
0	Invalid contents was found - energy in the zone T1
1	Invalid contents was found - energy in the zone T2
2	Invalid contents was found - energy in the zone T3
3	Invalid contents was found - energy in the zone T4
4	Invalid contents was found - total energy
5	Invalid contents was found - energy in zone T1 in the previous accounting period
6	Invalid contents was found - energy in zone T2 in the previous accounting period
7	Invalid contents was found - energy in zone T3 in the previous accounting period
8	Invalid contents was found - energy in zone T4 in the previous accounting period
9	Invalid contents was found - total energy in the previous accounting period
10-14	Not used
15	Incorrect value of the error register

11.2. Watt-hour meter registers in the programming and readout mode

Watt-hour meter registers are accessible in the programming and readout mode through the optical interface

Table 13

Identifier (ASCII characters)	Format ASCII characters	Parameter	Function
T	12:34:56; 25-11-02	Current time and date	R/W
A	1	Automatic change of the winter/summer time	R/W
I	AbcDeFgHiJ	User's identification number	R/W
N	02110001	Serial manufacturer's	R
D	7	Time of averaging power and number of sub-periods: (as in table 11)	R/W
E	17;13:55	Day and time in which the accounting period is closed (day '00' - automatic closure is disabled; day '01'... '28'; hour '00'... '23' : minute '00'... '59')	R/W
G	05	Kind of tariff group acc. to the table 11	R/W
H	07:20; 10:12; 22:30; 23:30	Variable hours for tariffs G12, G12w, C12b, C12w USEr	R/W
C	22112	Configuration of the serial link: mode, address, baud rate, acc. to the table 11	R/W
R	1	Clearing of registers related to interference with a strong magnetic field	R/W
Z	1010111	Selection of time zone for tariff hours, Saturdays, Sundays and holidays. (only for USEr tariff). 1 st character - selection of zone for hour interval since H1 till H2 2 nd character - selection of zone for hour interval since H2 till H3 3 rd character - selection of zone for hour interval since H3 till H4 4 th character - selection of zone for hour interval since H4 till H1 Meaning of 1... 4 character: 0 - T1 zone, 1 - T2 zone, 2 - T3 zone, 3 - T4 zone 5 th character - zone for Sathurdays (only for USEr tariff) 6 th character - zone for Sundays (only for USEr tariff) 7 th character - zone for holidays Meaning of 5... 7 character: 0 - as for the chosen tariff group, 1 - T1 zone, 2 - T2 zone, 3 - T3 zone, 4 - T4 zone In case when the '0' is chosen, time zones are defined acc. to the selected tariff group. (see the description of tariff zones in table 2).	R/W

Markings: R - only readout
R/W - readout and write

NOTE: In case of watt-hour meter configuration, when the given parameter is not used, the identification error code of the data 'ERROR (05)' is returned at the write or readout.

12. RS-485 or RS-232 INTERFACE with MODBUS protocol

Set of parameters of the LS31 watt-hour meter serial interface:

- identifier 0x9F
- watt-hour meter address 1...247
- baud rate 4800, 9600, 19200 bit/s,
- working mode ASCII, RTU,
- information unit ASCII: 8N1, 7E1, 7O1; RTU: 8N2, 8E1, 8O1, 8N1,
- maximal response time 600 ms.
- implemented functions 03 - readout of n registers; 17 - identification of the slave device

Factory settings: address 1, baud rate 9600 bauds, RTU 8N2 mode

Register map of the LS31 watt-hour meter

In the LS31 watt-hour meter, data are placed in 16-bit registers.

Process variables and parameters of the watt-hour meter are placed in the address area of registers in a way depending on the type of the variable value. Bits in the 16-bit register are numbered from the younger to the older (b0-b15).

Table with 16-bit registers of the watt-hour meter — Table 14

Register number	Parameter	Range	Description
4000	word	0... 65535	Watt-hour meter status ← Description in table 15
4001	word	2001... 2035	Current year
4002	word	101... 1231	Current date in format: month * 100 + day
4003	word	0... 2359	Bieżący czas w formacie: godzina * 100 + minuta
4004	MS word	0501000...	Serial number
4005	LS word	35129999	
4006	word	0x00...0xEE	User identifier (1 and 2 character)
4007	word	0x00...0xEE	User identifier (3 and 4 character)
4008	word	0x00...0xEE	User identifier (5 and 6 character)
4009	word	0x00...0xEE	User identifier (7 and 8 character)
4010	word	0x00...0xEE	User identifier (9 and 10 character)
4011	word)	0... 99999999	Active energy in zone T1 (kWhx100)
4012	LS word		
4013	MS word	0... 99999999	Active energy in zone T2 (kWhx100)
4014	LS word		
4015	MS word	0... 99999999	Active energy in zone T3 (kWhx100)
4016	LS word		
4017	MS word	0... 99999999	Active energy in zone T4 (kWhx100)
4018	LS word		

Table with 16-bit registers of the watt-hour meter Table 14

Register number	Parameter	Range	Description
4019	MS word	0... 99999999	Total active energy (kWhx100)
4020	LS word		
4021	MS word	0... 99999999	Total energy of phase L1 (kWhx100)
4022	LS word		
4023	MS word	0... 99999999	Total energy of phase L2 (kWhx100)
4024	LS word		
4025	MS word	0... 99999999	Total energy of phase L3 (kWhx100)
4026	LS word		
4027	MS word	0... 99999999	Active energy in zone T1 at the end of the previous accounting period (kWhx100)
4028	LS word		
4029	MS wordR	0... 99999999	Active energy in zone T2 at the end of the previous accounting period (kWhx100)
4030	LS word		
4031	MS word	0... 99999999	Active energy in zone T3 at the end of the previous accounting period (kWhx100)
4032	LS word		
4033	MS word	0... 99999999	Active energy in zone T4 at the end of the previous accounting period (kWhx100)
4034	LS word		
4035	MS word	0... 99999999	Total active energy at the end of the previous accounting period (kWhx100)
4036	LS word		
4037	word	0... 65535	Counter of accouting period closures
4038	word	2001... 2035	Year of accouting period closures
4039	word	101... 1231	Date of accouting period closure in format: month * 100 + day
4040	word	0... 2359	Time of accouting period closure in format: hour * 100 + minute
4041	word	0... 700	Highest value of averaged power (kW x 10)
4042	word	2001... 2035	Year in which the highest value of averaged power has occured
4043	word	101... 1231	Date in which the highest value of averaged power has occured, in format: month * 100 + day
4044	word	0... 2359	Time in which the highest value of averaged power has occured, in format: hour * 100 + minute
4045	word	0... 455	Highest value of averaged power in the previous accounting period (kW x 10)
4046	word	2001... 2035	Year in which the highest value of averaged power has occured in the previous accounting period
4047	word	101... 1231	Date in which the highest value of averaged power has occured in the previous accounting period, in format: month * 100 + day
4048	word	0... 2359	Time in which the highest value of averaged power has occured in the previous accounting period, in format: hour * 100 + minute
4049	word	0... 65535	Cumulated power (kW x 10)

Table with 16-bit registers of the watt-hour meter Table 14

Register number	Parameter	Range	Description
4050	word	0... 8	Way of power averaging: 0 - 15 min, sub-period 3 min 1 - 15 min, sub-period 5 min 2 - 15 min, sub-period 15 min 3 - 30 min, sub-period 6 min 4 - 30 min, sub-period 10 min 5 - 30 min, sub-period 30 min 6 - 60 min, sub-period 12 min 7 - 60 min, sub-period 20 min 8 - 60 min, sub-period 60 min
4051	word	0... 2359	Time of the automatic closure of the accounting period in the format: hour * 100 + minute
4052	word	0... 28	Day of the automatic closure of the accounting period (0 - automatic closure disabled)
4053	word	0... 32000	Impulse output constant (imp/kWh)
4054	word	0... 9	Tariff group: 0 - G11 1 - G12 2 - G12w 3 - C12a 4 - C12b 5 - C12w 6 - G13 7 - C22a 8 - C22b 9 - USEr (user's tariff)
4055	word	10... X	Nr of the program version (x10)
4056	word	0... 65535	Register of watt-hour meter errors ← description in the table 16.
4057	word	2000... 2035	Year of the first start of interference period by a strong magnetic field
4058	word	101... 1231	Month and day of the start of the first interference period by a strong magnetic field
4059	word	0... 2359	Time of the start of the first interference period by a strong magnetic field (sec)
4060	MS word	0... (2^{32}-1)	Duration of interference by a strong magnetic field [sek]
4061	LS word		
4062	word	...	Reserved
4063	word	0... 65535	Number of delation executions of interference by a strong magnetic field

Meaning of bits in the Status register (register 4000) Table 15

Bit	Description
0	Voltage signalling in the phase L1 0 - voltage below 0.9 Un 1 - voltage over 0.9 Un
1	Voltage signalling in the phase L2 0 - voltage below 0.9 Un 1 - voltage over 0.9 Un
2	Voltage signalling in the phase C 0 - voltage below 0.9 Un 1 - voltage over 0.9 Un
3 - 5	Current time zone: Bits: 5 4 3 0 0 1 - zone 1 0 1 0 - zone 2 0 1 1 - zone 3 1 0 0 - zone 4
6 - 7	Decimal place for power: Bits: 7 6 0 0 - without decimal places 0 1 - 1 decimal place 1 0 - 2 decimal place
8 - 9	Decimal place for energy: Bits: 9 8 0 0 - without decimal places 0 1 - 1 decimal place 1 0 - 2 decimal place
10 - 11	Prefix of unit for energy and power: Bits:11 10 0 0 - lack 0 1 - k 1 0 - M
12	Interference by a strong magnetic field: 0 - lack 1 - exist
13 - 14	Not used
15	Error - one must check the register of errors 0 - without error 1 - error exists

Meaning of bits in the register of errors (register 4056) Table 16

Bit	Description
0	Erroneous content was found - energy in zone T1
1	Erroneous content was found - energy in zone T2
2	Erroneous content was found - energy in zone T3
3	Erroneous content was found - energy in zone T4
4	Erroneous content was found - total energy
5	Erroneous content was found - energy in zone T1 in the previous accounting period
6	Erroneous content was found - energy in zone T2 in the previous accounting period
7	Erroneous content was found - energy in zone T3 in the previous accounting period
8	Erroneous content was found - energy in zone T4 in the previous accounting period
9	Erroneous content was found - total energy in the previous accounting period
10 - 14	Not used
15	Incorrect value of the register of errors

13. INTERNAL CONTROL CLOCK

The watt-hour meter comprises an astronomical clock supported by a battery. The current time is counted in the 24 hour format.

The clock has the function of automatic change of the winter time into the summer time and inversely. The change of time from the winter time into summer time is carried out in the night from Saturday to Sunday. In the last Sunday of March, the clock is reset from 2:00 till 3:00. The change of time from the summer time into the winter time is carried out in the night from Saturday to Sunday, in the last Sunday of October, the clock is reset from 3:00 till 2:00. If the user sets the current time between 2:00 and 3:00 in the last Sunday of October, the clocks accepts the summer time.

The function of automatic change of time can be disabled.

14. TECHNICAL DATA

Kinds of network	4-wire
Watt-hour meter connection way	direct
Reference voltage U_n	$3 \times 230/400$ V
Basic current I_b	5 or 10 A
Maximal current I_{max}	40, 60 or 100 A
Accuracy class	1 or 2

Working temperature range	- 25...+55°C
Storage temperature	- 30...+85°C
Readout field	special LCD display
Communication interfaces:	
- optical interface acc. to EN 62056-21,	
- RS-485, MODBUS protocol,	
- RS-232, MODBUS protocol,	
- Radio module:	
-transmission frequency	433.92 MHz
- band width	19.04 kHz
- emission power	below 10 mW
- baud rate	10 bit/s
- modulation	FSK
Output of energy pulses	output of OC type, passive acc. to EN 62053-31
Pulse time-constant of the OC type output	1000 imp./kWh
Pulse time-constant of the LED diode	1000 imp./kWh
Number of tariffs	1... 4
Accessible tariffs	G11, G12, G12w, G13, C12a, C12b, C12w, C22a, C22b, USEr
Power consumption:	
- in the voltage circuit	≤ 3.3 VA/phase
- in the current circuit	≤ 0.02 VA
Starting current:	0.004 I_b
Detection level of the voltage presence	0.9 U_n
Resistance against external permanent magnetic field	640 kA/m
Resistance against voltage surges	4 kV
Watt-hour meter reaction against phase decays:	- preservation of data and watt-hour meter state after a 3-phase decay in the non-volatile FRAM memory, - storage life: min. 15 years, - work continuation when a 1 or 2-phase decay occurs.
Battery life	min. 10 years
Clock accuracy	± 3s/day
Standards fulfilled by the watt-hour meter	EN 62052-11, EN 62053-2
Approved by the Central Measurement Office	PLT 0648
Protection degree ensured by the housing	IP 54
External dimensions (H × W × D)	328 × 176 × 65 mm
Weight	ca. 2.0 kg

15. ORDERING CODES

LS31 electronic 3-phase watt-hour meter for direct measurements with an LCD display and a optical interface.

Electronic watt-hour meter LS31	X	X	XX	X	X

Basic and maximal current:

5 (40) A	**1**
5 (60) A	**2**
10 (100) A	**3**
5 (100) A [1)]	**4**
on order	**X**

Input voltage:

3 × 230/400 V	**1**
on order	**X**

Communication interface:

optical port	**00**
optical port + output of O/C type	**01**
optical port + RS-485, Modbus protocol	**02**
optical port + RS-232, Modbus protocol	**04**
optical port + SRD radio module (1E)	**20**
on order	**XX**

Accuracy class:

1	**1**
2	**2**

Acceptance tests:

without legalisation	**8**
with a legalisation certificate	**7**
acc. customer's agreement[1)]	**X**

[1)] - Custom-made version, must be agreed with the manufacturer.

ORDERING EXAMPLE:

The code: **LS31 3 1 02 7** means:

LS31 - watt-hour meter of LS31 type
3 - basic and maximal current: 10 (100) A
1 - input voltage: 3 x 230/400 V
02 - with an optical port + RS-485, MODBUS protocol,
1 - class 1 of accuracy,
7 - with a legalisation certificate.

16. MAINTENANCE AND WARRANTY

The LS31 watt-hour meter does not require any periodical maintenance.

In case of some incorrect operations:

1. After the dispatch date and within the period stated in the warranty card

One should return the instrument to the Manufacturer's Quality Inspection Dept. If the instrument has been used in compliance with the instructions, the Manufacturer warrants to repair it free of charge.

The disassembling of the housing causes the cancellation of the granted warranty.

2. After the warranty period:

One should send the instrument to repair it in an authorized service workshop.

Spare parts are available for the period of five years from the date of purchase.

Our policy is one of continuous improvement and we reserve the right to make changes in design and specifications of any products as engineering advances or necessity requires and revise the above specifications without notice.

LS31-09A

LUMEL S.A.
ul. Słubicka 1, 65-127 Zielona Góra, Poland
Tel.: (48-68) 45 75 100 (exchange)
Fax: (48-68) 45 75 508
e-mail:lumel@lumel.com.pl
http://www.lumel.com.pl

Export Department:
Tel.: (48-68) 45 75 139/305/321/386
Fax: (48-68) 32 54 091
e-mail: export@lumel.com.pl